

Figure 6-5. CVUS Hub FM/TV Transmission

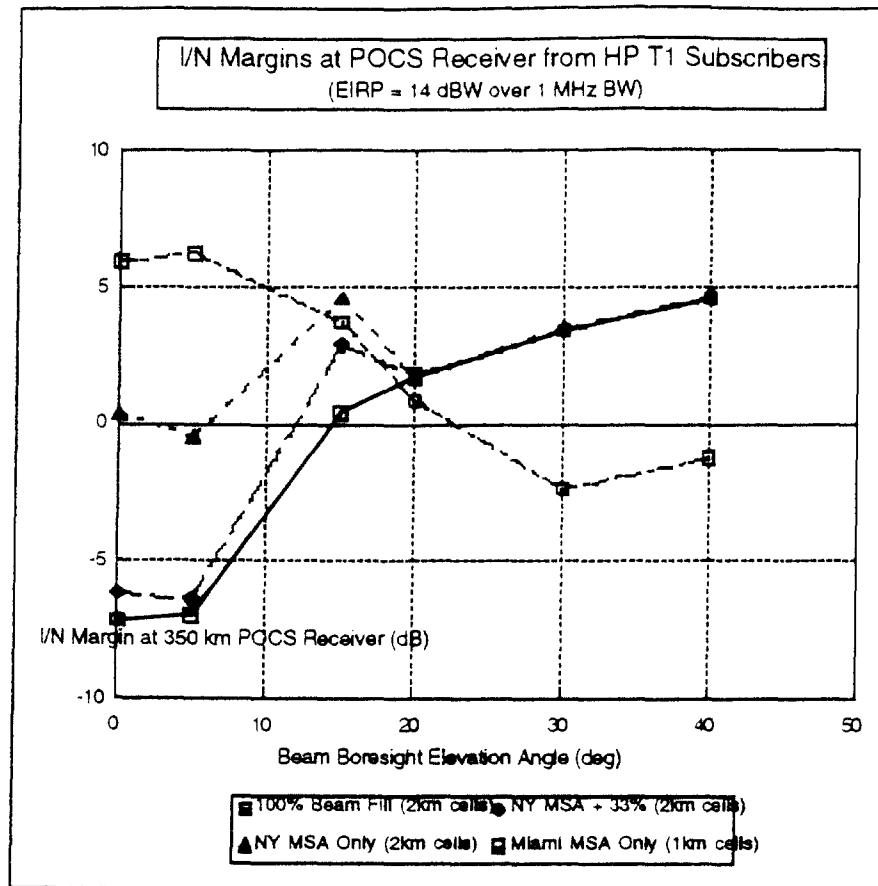


Figure 6-6. HP Subscriber T1 Transmission

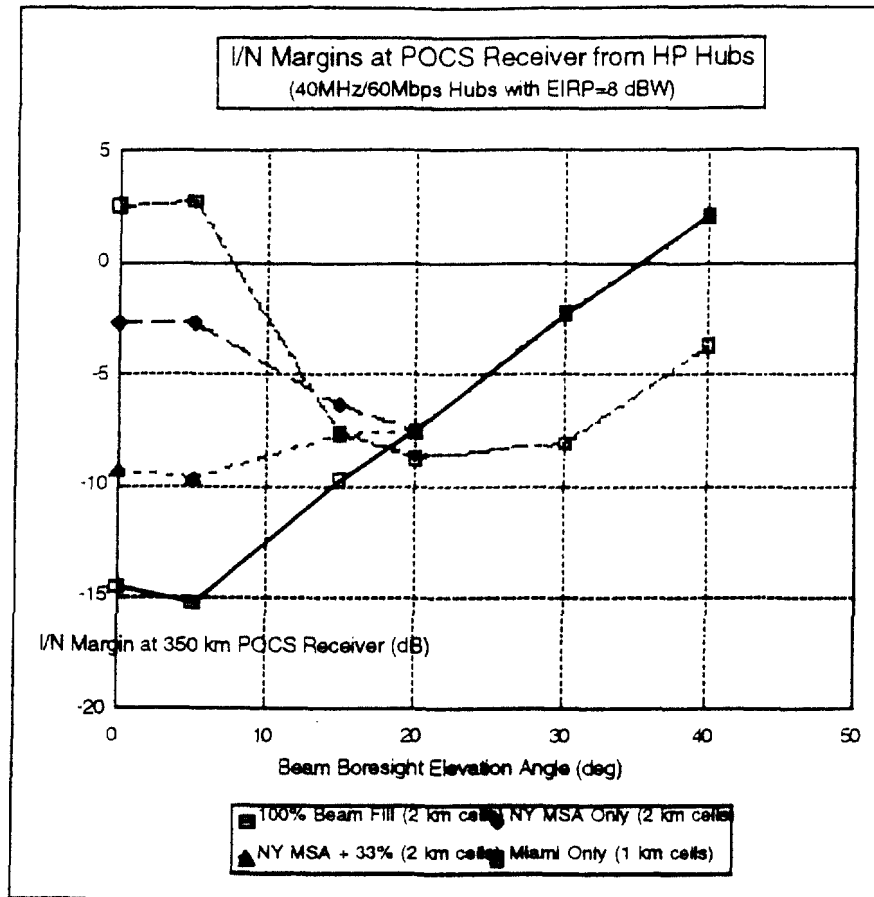


Figure 6-7. HP Hub 40 MHz/60 Mbps Transmission

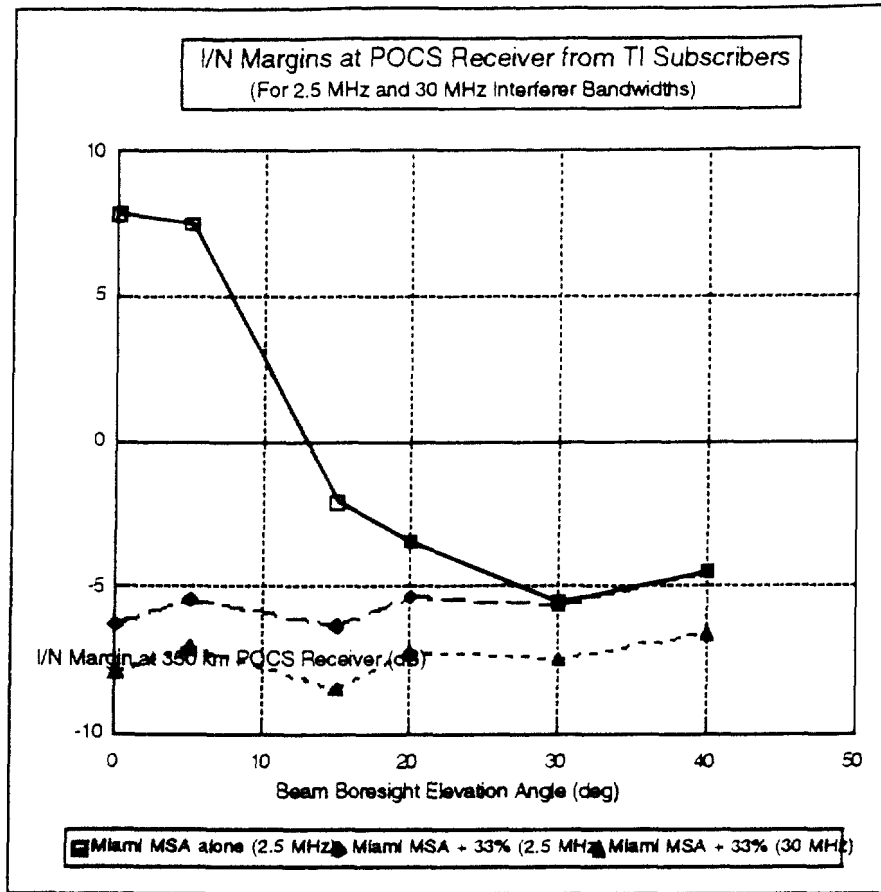


Figure 6-8. TI Subscriber 2.5 & 30 MHz Transmissions

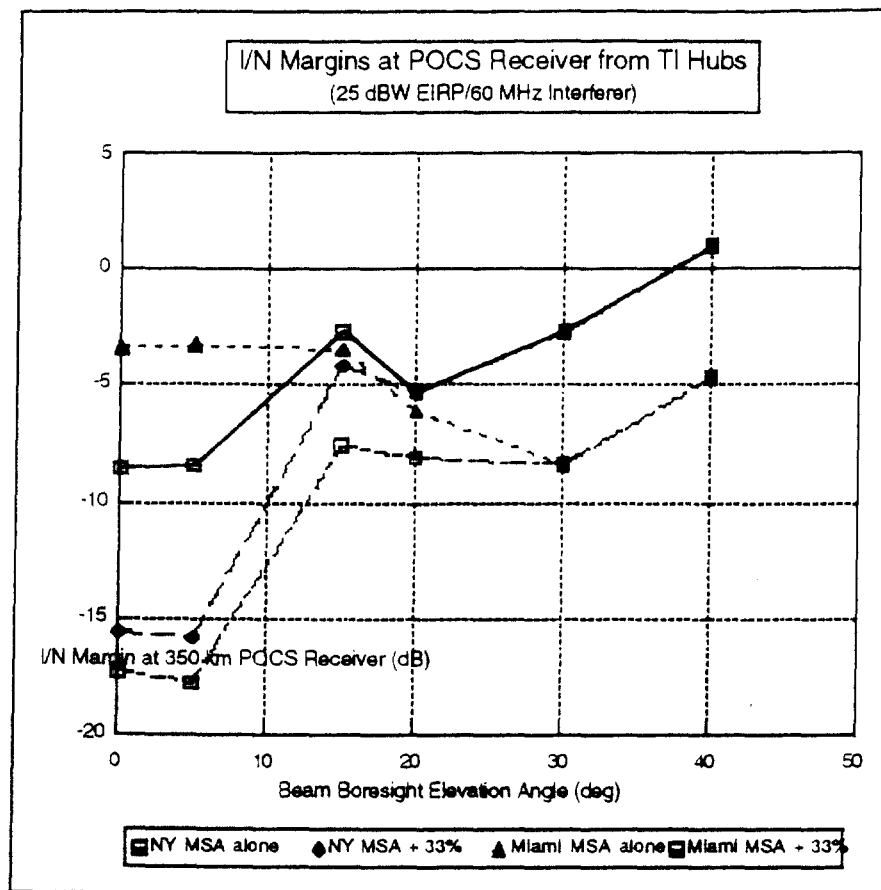


Figure 6-9. TI Hub 25 dBW EIRP/60 MHz Transmission

6.4 Impact of the proposed EIRP mask on POCS

The Third NPRM proposed an EIRP limit on LMDS systems in the form of a maximum EIRP expressed in terms of dBW/MHz/km² (see §4.2). This EIRP mask was evaluated with respect to the levels of interference that would be received by a POCS satellites receiver as a function of elevation angle from the LMDS emitters for Rain Zones 1, 2 & 3, with the results given in Figure 6-10.

As can be seen in the figure, interference is produced at elevation angles from 0° to 11° in all three rain zones.

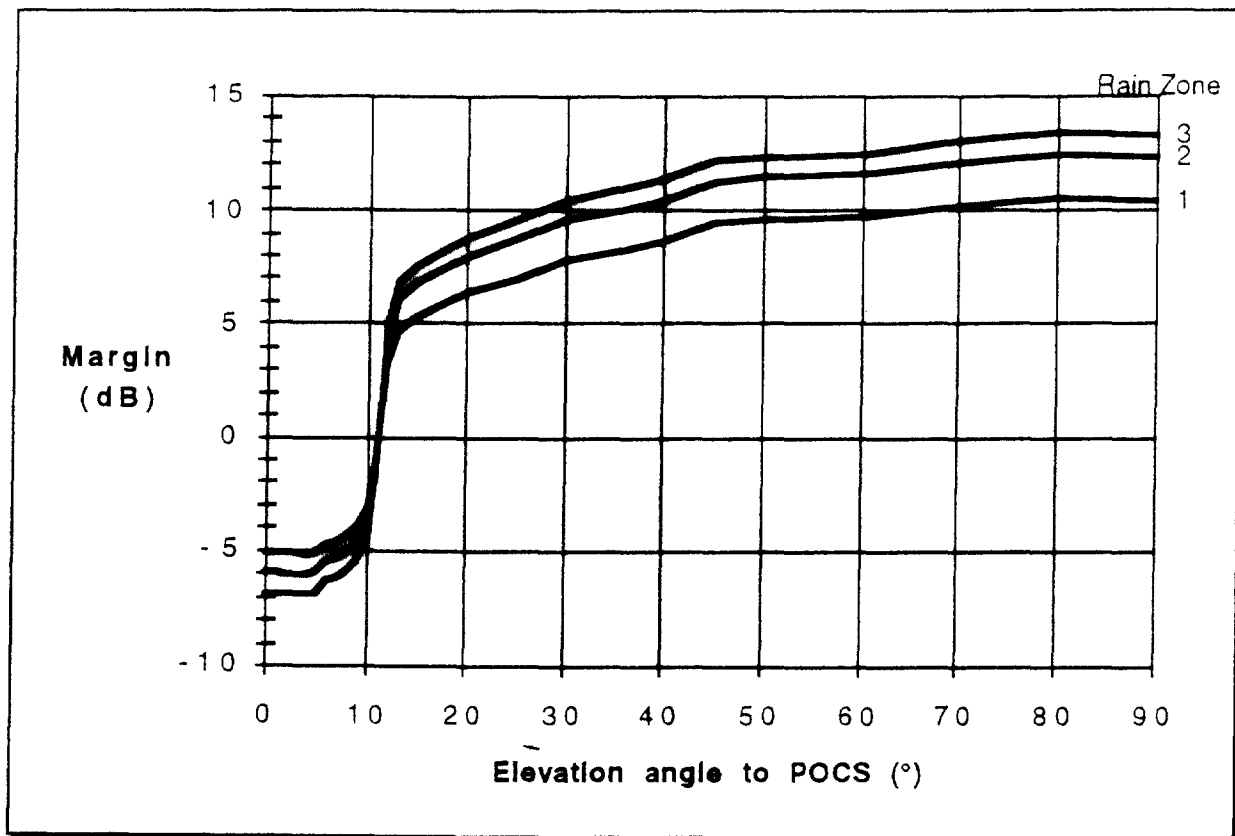


Figure 6-10. Interference impact of EIRP Mask on POCS

6.5 Results of the Canadian study

An analysis was prepared by Canada of interference from the LMCS system (similar to LMDS) into the POCS (SFCG 15-39). The modeled LMCS system was of relatively low power, as discussed in §5.4.

Even for these low powered transmitters, the Canadian report concluded that the POCS would receive interference.

7. Impact of modeled LMDS systems on EES downlinks

The Negotiated Rulemaking Committee for LMDS concluded that sharing between LMDS and Earth stations operating with low-Earth orbit satellites was not feasible within the same geographical area. In the case of EES downlinks, the Earth stations are receiving Earth stations rather than transmitting stations as is the case in the 27.5 - 30.0 GHz band, but the basic concepts remain the same. The LMDS system, by its ubiquity, would make it impracticable to coordinate Earth station locations within an LMDS service area.

8. Conclusions

NASA has undertaken an intensive study to assess the feasibility of sharing between NASA space services and LMDS services below 27.5 GHz. The study has concentrated on the potential impact to Data Relay Satellite Systems and Proximity Operations Communications Systems, as well as a limited assessment of the potential impact to Earth Exploration Satellite services. Our analyses show that unacceptable interference would result from both LMDS hub and LMDS subscriber transmissions for three of the four LMDS proponent systems currently before the FCC.

LMDS system	Interference margin	
	TDRS	POCS
CVUS Hub	-9.4	-9.0
CVUS Sub	1.1	-1.1
CVUS Hub (25 dBW/MHz)	-33.4	-32.9
CVUS Sub (25 dBW/MHz)	-13.9	-16.1
Endgate Hub	15.5	13.3
Endgate Sub	36.9	36.2
HP Hub	-13.9	-14.4
HP Sub	-7.3	-7.7
TI Hub	-16.5	-16.3
TI Sub	-8.2	-10.1
EIRP mask	-7.0	-7.0

Figure 8-1. Interference margin summary

Figure 8-1 shows the interference margins for TDRS and POCS from data in figures 5-3, 5-4 and 6-2, 6-3. Significant negative margins were found for the LMDS systems proposed by CellularVision, Hewlett Packard and Texas Instrument. Only the Endgate system parameters resulted in positive margins for the TDRS and POCS systems.

While interference is most severe for elevation angles to the satellite below 10°, unacceptable interference is found for elevations to 50° under several cases (e.g. interference into POCS from HP and TI subscribers in high rain areas of the country).

NASA concludes that sharing between NASA space services and LMDS systems is not feasible in the band below 27.5 GHz. We further conclude that due to the magnitude of unacceptable interference resulting from three of the four LMDS system types currently before the FCC, no rules acceptable to all parties could be drafted which would guarantee protection of NASA space services from harmful interference.

Appendix A

Results of detailed analyses of interference

Elev.	CV Hub 1	CV Hub 2	CV Hub 3	CV Hub 1-25	End Hub 1	End Hub 2	End Hub 3	HP Hub 1	HP Hub 2	HP Hub 3	TI Hub 1	TI Hub 2	TI Hub 3
0	-9	-7	-3	-33	16.2	17.6	21.3	-12.1	-2.1	-3.4	-16.0	-12.3	-14.0
1	-9.1	-6.7	-2.5	-33.1	16.2	17.6	21.2	-12.2	-2.2	-3.5	-16.1	-12.4	-14.0
2	-9.1	-6.6	-2.5	-33.1	16.2	17.7	21.2	-12.3	-2.3	-3.6	-16.0	-12.3	-13.9
3	-9.1	-6.6	-2.5	-33.1	16.0	17.8	21.2	-12.6	-2.5	-3.7	-16.1	-12.3	-13.8
4	-9.4	-7.0	-2.7	-33.4	15.6	17.3	21.0	-13.4	-3.2	-4.3	-16.5	-12.6	-14.1
5	-9.2	-6.6	-2.5	-33.2	15.5	17.6	21.2	-13.7	-3.4	-4.4	-16.3	-12.5	-13.9
6	-8.6	-5.8	-1.4	-32.6	15.8	18.1	22.2	-13.8	-3.3	-4.2	-15.8	-11.9	-13.3
7	-7.7	-4.8	-0.4	-31.7	16.2	18.7	23.2	-13.9	-3.3	-4.1	-15.1	-11.1	-12.3
8	-4.6	-1.1	3.9	-28.6	17.8	21.2	26.4	-13.2	-2.3	-2.9	-12.6	-7.9	-8.6
9	1.6	5.5	10.5	-22.4	19.6	23.4	28.5	-11.8	-0.7	-1.2	-8.6	-3.5	-4.0
10	6.8	11.0	16.4	-17.2	20.9	24.9	30.1	-10.1	1.2	0.8	-6.2	-0.9	-1.3
11	9.4	13.8	19.2	-14.6	22.0	26.0	31.4	-8.7	2.7	2.4	-5.2	0.3	-0.0
12	9.7	14.1	19.6	-14.3	22.8	26.9	32.2	-8.0	3.4	3.1	-5.0	0.5	-0.2
13	10.1	14.7	20.1	-13.9	23.9	28.2	33.5	-7.5	4.1	3.8	-4.5	1.0	-0.7
15	10.2	14.8	20.4	-13.8	25.2	29.5	35.0	-7.3	4.2	3.9	-4.4	1.2	-0.9
20	11.2	15.9	21.4	-12.8	28.5	32.9	38.3	-5.3	6.4	6.3	-3.4	2.2	-2.0
25	12.0	16.7	22.5	-12.0	31.1	35.4	41.2	-2.7	9.1	8.9	-1.7	4.0	-3.9
30	12.6	17.4	23.2	-11.4	33.2	37.6	43.1	-0.7	11.1	10.9	1.4	7.2	-7.0
35	13.4	18.3	23.9	-10.6	35.3	39.7	45.3	1.3	13.1	13.0	3.6	9.4	-9.3
40	15.5	20.4	26.0	-8.5	36.8	41.0	47.3	2.8	14.6	14.5	4.1	9.9	-9.8
45	17.4	22.2	27.9	-6.6	38.0	42.3	48.3	3.9	15.8	15.7	4.3	10.1	-10.1
50	19.5	24.3	29.9	-4.5	39.3	43.7	49.9	5.1	17.0	16.9	4.6	10.5	-10.4
60	23.6	28.5	34.4	-0.4	41.6	46.0	52.3	7.3	19.3	19.2	5.3	11.2	-11.1
70	25.3	30.1	36.4	1.3	43.0	47.3	53.4	8.7	20.6	20.5	5.6	11.4	-11.3
80	25.1	29.9	36.3	1.4	44.2	48.5	54.6	9.7	21.7	21.6	5.5	11.3	-11.3
90	25.6	30.5	36.7	1.6	45.6	50.1	55.7	11.1	23.0	23.0	5.9	11.7	-11.6

**Figure A-1. Aggregate Interference from LMDS Hubs into a
TDRS Satellite Receiver**

Elev	CV Sub 1	CV Sub 2	CV Sub 3	CV Sub 1-25	End sub 1	End sub 2	End sub 3	HP Sub 1	HP Sub 2	HP Sub 3	TI Sub 1	TI Sub 2	TI Sub 3
0	2.1	4.5	8.7	-12.9	37.1	37.2	40.5	-7.1	1.3	-1.1	-7.1	-3.5	-5.2
1	2.1	4.5	8.7	-12.9	37.0	37.2	40.5	-7.1	1.2	-1.1	-7.2	-3.5	-5.2
2	2.0	4.5	8.7	-13.0	37.1	37.4	40.5	-7.0	1.3	-1.0	-7.2	-3.5	-5.1
3	1.8	4.4	8.7	-13.2	37.1	37.7	40.6	-7.0	1.4	-1.0	-7.4	-3.6	-5.1
4	1.3	3.9	8.3	-13.7	36.9	37.4	40.5	-7.3	1.2	-1.1	-8.0	-4.1	-5.5
5	1.1	4.0	8.3	-13.9	37.0	38.1	40.8	-7.2	1.5	-0.6	-8.2	-4.1	-5.5
6	1.2	4.3	8.9	-13.8	37.8	38.7	42.7	-6.5	2.4	0.3	-8.1	-3.9	-5.1
7	1.1	4.5	9.2	-13.9	38.8	40.2	43.9	-5.8	3.5	1.6	-8.1	-3.6	-4.7
8	1.9	5.8	11.1	-13.1	42.3	45.8	51.0	-3.0	7.9	7.3	-7.3	-2.2	-2.8
9	2.8	7.0	12.3	-12.2	43.3	47.1	52.3	-1.8	9.3	8.9	-6.3	-1.1	-1.5
10	3.3	7.6	13.0	-11.7	43.9	47.9	53.1	-1.3	10.0	9.7	-5.8	-0.4	-0.8
11	3.6	8.1	13.5	-11.4	44.5	48.5	53.8	-0.9	10.5	10.2	-5.3	0.1	-0.2
12	3.8	8.3	13.7	-11.2	44.8	48.9	54.1	-0.7	10.7	10.4	-5.1	0.4	0.1
13	4.4	9.0	14.4	-10.6	45.5	49.7	55.0	-0.2	11.3	11.0	-4.3	1.3	1.1
15	4.7	9.3	14.9	-10.3	46.0	50.2	55.7	-0.1	11.4	11.2	-2.9	2.7	2.4
20	6.1	10.8	16.3	-8.9	47.7	52.0	57.4	0.8	12.5	12.3	-0.2	5.4	5.2
25	7.2	11.9	17.7	-7.8	49.0	53.3	59.1	1.6	13.3	13.2	0.5	6.3	6.1
30	8.0	12.9	18.6	-7.0	50.1	54.5	60.0	2.2	13.9	13.8	1.2	6.9	6.8
35	9.0	13.8	19.4	-6.0	51.3	55.6	61.2	2.9	14.7	14.6	1.9	7.6	7.5
40	9.5	14.4	20.0	-5.5	52.0	56.3	62.5	3.3	15.2	15.1	2.3	8.1	8.0
45	10.3	15.2	20.8	-4.7	52.5	56.8	62.8	3.5	15.4	15.3	2.5	8.4	8.3
50	12.1	16.9	22.4	-2.9	53.2	57.6	63.8	3.9	15.8	15.7	2.8	8.7	8.6
60	13.2	18.0	23.9	-1.8	54.5	58.9	65.1	4.6	16.6	16.5	3.6	9.4	9.3
70	12.9	17.6	24.0	-2.1	54.9	59.3	65.4	4.8	16.7	16.6	3.8	9.6	9.5
80	12.2	17.0	23.3	-2.8	55.3	59.6	65.7	4.7	16.7	16.6	3.8	9.6	9.5
90	12.2	17.1	23.4	-2.8	56.1	60.6	66.2	5.2	17.1	17.1	4.2	9.9	9.9

Figure A-2. Aggregate Interference from LMDS subscribers into a TDRS satellite receiver

Elev	CV Hub 1	CV Hub 2	CV Hub 3	CV Hub 1-25	End Hub 1	End Hub 2	End Hub 3	HP Hub 1	HP Hub 2	HP Hub 3	TI Hub 1	TI Hub 2	TI Hub 3
0	-8.9	-6.6	-2.8	-32.9	14.9	13.3	14.9	-13.8	-3.5	-4.6	-16.1	-12.7	-14.2
1	-8.9	-6.6	-2.8	-32.9	14.9	13.3	14.9	-13.8	-3.6	-4.6	-16.1	-12.7	-14.2
2	-8.9	-6.6	-2.8	-32.9	14.9	13.3	14.9	-13.9	-3.6	-4.6	-16.1	-12.7	-14.2
3	-9.0	-6.6	-2.8	-33.0	15.2	13.3	14.9	-14.0	-3.8	-4.7	-16.2	-12.8	-14.2
4	-9.0	-6.6	-2.8	-33.0	15.2	13.4	15.0	-14.1	-3.9	-4.9	-16.2	-12.8	-14.2
5	-9.0	-6.6	-2.8	-33.0	15.3	14.0	15.4	-14.3	-4.0	-5.0	-16.3	-12.8	-14.2
6	-8.6	-6.5	-2.7	-32.6	15.3	14.1	15.8	-14.3	-4.1	-5.1	-16.0	-12.4	-13.8
7	-8.5	-6.4	-2.5	-32.5	15.5	14.3	16.0	-14.4	-4.2	-5.1	-15.9	-12.3	-13.7
8	-8.3	-5.7	-1.7	-32.3	15.8	14.6	16.4	-14.4	-4.2	-5.1	-15.8	-12.1	-13.4
9	-7.9	-5.3	-1.3	-31.9	16.1	15.1	16.8	-14.4	-3.9	-4.7	-15.3	-11.8	-13.1
10	-7.1	-4.6	0.1	-31.1	17.1	16.4	18.9	-14.2	-3.7	-4.5	-14.9	-11.1	-12.3
11	-5.3	-2.3	2.5	-29.3	20.3	21.1	22.3	-13.8	-3.1	-3.7	-13.6	-9.2	-10.2
12	0.4	4.3	9.8	-23.6	25.1	28.8	34.2	-12.9	-1.9	-2.3	-10.4	-5.2	-5.7
13	5.0	9.4	14.9	-19.0	27.1	30.9	36.5	-11.8	-0.6	-0.9	-8.5	-3.2	-3.5
15	6.9	11.4	17.1	-17.1	30.0	34.0	39.4	-10.4	0.9	0.6	-7.7	-2.2	-2.4
20	7.9	12.5	18.5	-16.1	34.9	39.2	45.5	-8.0	3.5	3.3	-6.8	-1.1	-1.3
25	8.7	13.3	19.0	-15.3	38.6	42.9	49.2	-4.4	7.3	7.1	-5.1	0.6	0.4
30	9.3	14.1	19.9	-14.7	41.3	46.0	51.4	-1.5	10.3	10.2	-2.0	3.9	3.5
35	10.1	14.9	20.6	-13.9	43.9	48.4	53.6	1.0	12.9	12.7	0.0	5.9	5.7
40	12.1	16.8	23.4	-11.9	45.9	50.2	56.0	3.2	15.2	15.1	0.7	6.4	6.3
45	14.2	18.9	25.4	-9.8	47.7	52.1	57.2	5.1	16.9	16.8	0.9	7.2	7.1
50	16.3	21.2	27.0	-7.7	49.2	54.3	60.2	6.7	18.6	18.6	1.2	7.4	7.3
60	20.1	25.0	30.9	-3.9	52.2	56.9	62.0	9.6	21.7	21.7	1.7	7.5	7.4
70	21.9	26.4	34.1	-2.1	54.4	59.4	64.0	11.8	24.0	23.9	2.0	8.0	7.9
80	22.3	26.7	33.7	-1.7	55.8	60.8		13.7	25.8	25.7	2.3	8.4	8.3
90	22.3	26.6	33.7	-1.7	57.4	61.9		15.0	27.3	27.3	2.2	8.3	8.2

Figure A-3. Interference from LMDS Hub into the POCS as a function of elevation angle to the POCS

Elev	CV Sub 1	CV Sub 2	CV Sub 3	CV Sub 1-25	END Sub 1	END Sub 2	END Sub 3	HP Sub 1	HP Sub 2	HP Sub 3	TI Sub 1	TI Sub 2	TI Sub 3
0	0.2	3.1	7.3	-14.8	36.3	36.7	40.1	-7.5	1.1	-1.0	-9.0	-1.3	-6.5
1	0.2	3.0	7.3	-14.8	36.2	36.7	40.1	-7.5	1.1	-1.0	-9.0	-1.3	-6.5
2	0.1	3.0	7.2	-14.9	36.2	36.7	40.1	-7.6	1.1	-1.1	-9.1	-1.9	-6.6
3	-0.1	2.9	7.1	-15.1	36.5	36.7	40.1	-7.6	1.0	-1.1	-9.3	-2.0	-6.7
4	-0.3	2.7	7.0	-15.3	36.4	36.7	40.2	-7.6	1.0	-1.1	-9.4	-2.1	-6.8
5	-0.5	2.5	6.9	-15.5	36.4	37.2	40.3	-7.7	1.0	-1.1	-9.7	-2.0	-6.9
6	-0.5	2.4	6.8	-15.5	36.3	37.3	40.4	-7.7	1.0	-1.0	-9.7	-2.1	-6.7
7	-0.8	2.3	6.8	-15.8	36.4	37.4	40.6	-7.6	1.1	-0.9	-9.9	-2.2	-6.8
8	-0.9	2.5	7.1	-15.9	36.5	37.6	40.9	-7.6	1.2	-0.7	-10.1	-2.3	-6.8
9	-1.1	2.4	7.1	-16.1	36.6	37.9	41.3	-7.4	1.8	0.0	-10.0	-2.3	-6.7
10	-0.9	2.6	7.6	-15.9	37.3	38.9	43.0	-7.1	2.1	0.4	-10.0	-1.9	-6.4
11	-0.7	3.2	8.6	-15.7	38.9	41.5	45.5	-6.1	4.2	3.0	-9.7	-1.1	-5.4
12	-0.1	4.1	9.8	-15.1	40.6	44.5	50.0	-4.7	6.5	6.1	-8.9	0.0	-4.0
13	0.2	4.7	10.2	-14.8	41.1	45.1	50.6	-4.3	7.0	6.7	-8.2	0.7	-3.2
15	0.9	5.4	11.1	-14.1	42.1	46.1	51.5	-3.7	7.6	7.3	-7.0	2.2	-1.7
20	2.4	7.0	12.9	-12.6	43.9	48.1	54.4	-2.9	8.7	8.5	-4.0	5.3	1.8
25	3.4	8.0	13.8	-11.6	45.3	49.6	55.9	-2.2	9.5	9.4	-3.2	6.2	2.8
30	4.3	9.1	14.8	-10.7	46.2	51.0	56.3	-1.6	10.2	10.1	-2.6	7.1	3.2
35	5.0	9.9	15.6	-10.0	47.3	51.8	57.0	-1.1	10.7	10.6	-2.1	7.5	3.6
40	5.6	10.3	16.9	-9.4	48.1	52.4	58.1	-0.6	11.4	11.3	-1.5	7.7	4.1
45	6.7	11.4	17.9	-8.3	48.8	53.1	58.1	-0.2	11.5	11.5	-1.3	8.2	4.7
50	8.4	13.3	19.1	-6.6	49.3	54.3	60.3	0.1	12.0	11.9	-1.0	9.1	5.1
60	9.2	14.1	19.8	-5.8	50.5	55.1	60.2	0.6	12.8	12.7	-0.5	9.4	5.2
70	9.0	13.5	21.2	-6.0	51.2	56.2	60.7	0.9	13.0	12.9	-0.2	10.1	5.5
80	8.9	13.3	20.4	-6.1	51.4	56.4		1.1	13.1	13.0	0.1	9.9	5.1
90	8.5	12.9	19.9	-6.5	52.0	56.6		1.1	13.4	13.4	0.0	9.9	5.0

Figure A-4. Interference from LMDS Subscriber into the POCS as a function of elevation angle to the POCS

APPENDIX B

LMDS AGGREGATE INTERFERENCE INTO POCS RECEIVERS CONSIDERING SPECIFIC MSA AREAS

LMDS AGGREGATE INTERFERENCE INTO POCS RECEIVERS

To estimate the amount of aggregate interference introduced into proximity operations space receivers, a MATLAB computer simulation program was developed. Space system receiver input parameters are:

- 1) Space Station altitude (assumed to be 350 km)
- 2) Receive HPBW (assumed to be 5.9°)
- 3) Receive antenna gain (assumed to be 32.55 dBi)
- 4) Receive system noise temperature (assumed to be 733°K)
- 5) Receive system bandwidth (14.7 MHz in most cases)

LMDS system input parameters are:

- 1) Max EIRP (at cell edge for subscribers)
- 2) Transmit signal bandwidth
- 3) LMDS cell radius
- 4) Height of hub above ground level
- 5) Maximum pointing elevation of subscriber antennas
- 6) Hub antenna mainbeam elevation angle (since hubs are typically pointed slightly downward)
- 7) Modulation peaking factor (for the case of a wideband interferer into a narrowband receiver)
- 8) Rain climate zone (consistent with the cell size above)
- 9) Number of simultaneous co-frequency subscribers per cell (assumed to be one for all systems except ENDGATE which uses a 36-sectorized cell)
- 10) Frequency interleaving (assumed to be -3 dB for CV and 0 for all others)

Additionally, 3 dB beam footprint areas for various beam aimpoint elevation angles are input to the simulation. These footprint areas were pre-calculated off-line using a separate program since they involve a significant amount of computation by their own right.

A "FILL" vector specifying various LMDS beam fill percentages and the areas of selected MSAs (metropolitan statistical areas) are also input to the simulation. These variables are used to compute the "effective LMDS area" which is defined to be that area occupied by LMDS cells. This is to take into account the fact that beam footprints (especially large ones that occur at low elevation angles) will typically not be completely saturated with LMDS systems. The program provides three options for computing effective area. These are described below with the aid of the following figure.

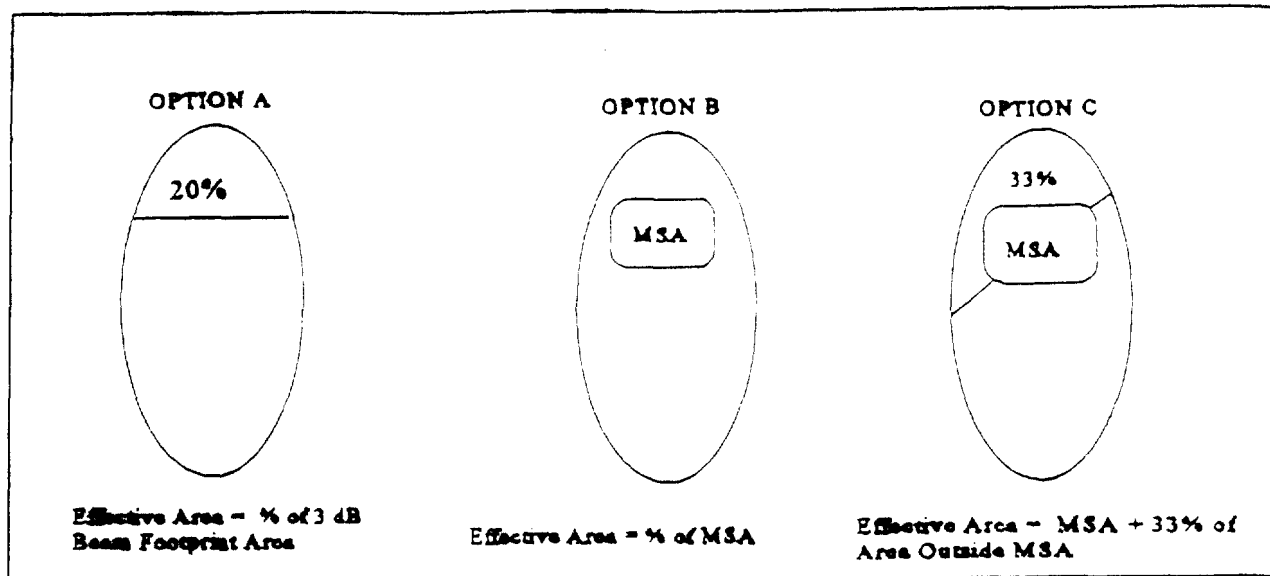


Figure 1. Options for Computing Effective Area Occupied by LMDS Cells

Option A uses the % fill values to simply calculate the effective area as a specified percentage of the 3 dB beam footprint area. For example, a fill percentage of 20% would take the effective area as 20% of the footprint area. The approximate number of LMDS cells in the footprint is then found by dividing the effective area by the LMDS cell area.

In option B, the fill percentage is interpreted as a certain percentage of the MSA area. For example, a fill percentage of 100% would take the effective area to be the entire MSA area *as long as the beam footprint is larger than the MSA*. The rest of the footprint is assumed to be completely empty of LMDS cells. *If the beam footprint, on the other hand, is smaller than the MSA itself, the effective area is taken to be equal to the beam area even if a 100% MSA coverage is specified.* This typically happens at higher elevation angles.

Option C is similar and is analogous to the Canadian approach for computing effective area. Again, if the beam footprint is larger than the MSA (as shown in the figure), and 100% MSA coverage is specified, the effective area is taken to be the entire MSA + 33% of the remaining footprint area outside the MSA. Like option B, however, if the beam footprint is smaller than the MSA, then the effective area is simply taken to be the beam footprint area itself. Again, this typically occurs at the higher elevation angles. Hence, at the higher elevation angles, the I/N margin values for a particular scenario will generally be the same for both Options B and C.

Once the LMDS effective area is calculated according to one of the three options above, the approximate number of LMDS cells in the beam footprint is found by dividing the effective area by the cell area. For subscriber interference, the number of co-channel interferers per cell whose carriers fall into the POCS receive bandwidth is then found by comparing the receiver bandwidth with the interferer's bandwidth. For example, an LMDS scenario in which an individual

subscriber's bandwidth is 1 MHz (for a T1 data rate) and the space system receive bandwidth is 14.7 MHz, will assume 15 subscriber interferers per cell. In addition, if there is frequency reuse within the cell by means of sectorization (as in the case of ENDGATE with 36 sectors), the number of potential interferers per cell is further multiplied by this factor.

For the estimated number of LMDS cells in the footprint (NCELL), the program then populates the footprint with cells starting at the far edge of the footprint and progressing towards the near edge. For each cell, the elevation angle to the satellite is computed as well as the gain fall-off at the satellite antenna. The atmospheric loss for each cell is also calculated based on its elevation angle and the specified rain-climate zone. Because the cell sizes are much smaller than the distance to the satellite, all subscribers within a cell are assumed to have the same satellite elevation angle, atmospheric loss, and gain fall-off at the satellite as that computed for the particular cell itself. (Note, however, that pointing angles and gain falloffs at the subscriber antenna are computed for every subscriber in every cell.) At this point, the algorithm branches into two separate paths depending on whether subscribers or hubs are being analyzed. Since subscriber interference is more complicated, the rest of this description pertains only to subscriber analysis, although the hub analysis is very similar.

After populating the footprint with the appropriate number of cells, the interferers within a cell are randomly located within each cell. For example, for the case described above with 15 T1 interferers per cell, 15 interferers would be randomly distributed in each of the NCELL cells within the footprint. (Note that in some cases as seen in the table, one interferer per cell is deliberately forced into azimuth alignment with the satellite to study its effect.). After the subscribers have been randomly distributed in the cells, a number of parameters are calculated for each subscriber. These are:

- 1) Subscriber-to-hub ranges within each cell
- 2) Subscriber EIRP as a function of subscriber-to-hub distance
- 3) Subscriber antenna elevation angle based on distance to hub and hub height above ground level
- 4) Off-axis angle of each subscriber's antenna pointing direction (towards the hub) from its line-of-sight to the satellite
- 5) Using the off-axis angles in (4) and the specified subscriber antenna pattern, the corresponding subscriber antenna gain falloffs are computed
- 6) The subscriber antenna gain falloffs are checked to see which ones are less than 3 dB. Where this occurs, it indicates main-beam coupling and a 3 dB polarization discrimination is assumed.
- 7) The slant range and free-space loss are computed for each subscriber
- 8) The interference power at the satellite is computed from each subscriber transmitter in each of the NCELLS taking into account extra factors such as interleaving, peaking, and bandwidth adjustment (for a wideband interferer into a narrowband receiver) where they apply.
- 9) After converting the individual interfering powers from dB to non-dB units (Watts), the aggregate interference power is computed by summing over all subscriber interference powers.
- 10) The thermal noise power N in dBW is subtracted from the aggregate interference power I in dBW to get the I/N ratio.
- 11) The I/N ratio is compared with the I/N criterion of -6 dB to get the margin.

This procedure is repeated for each of the specified beam footprint areas and % coverage values.

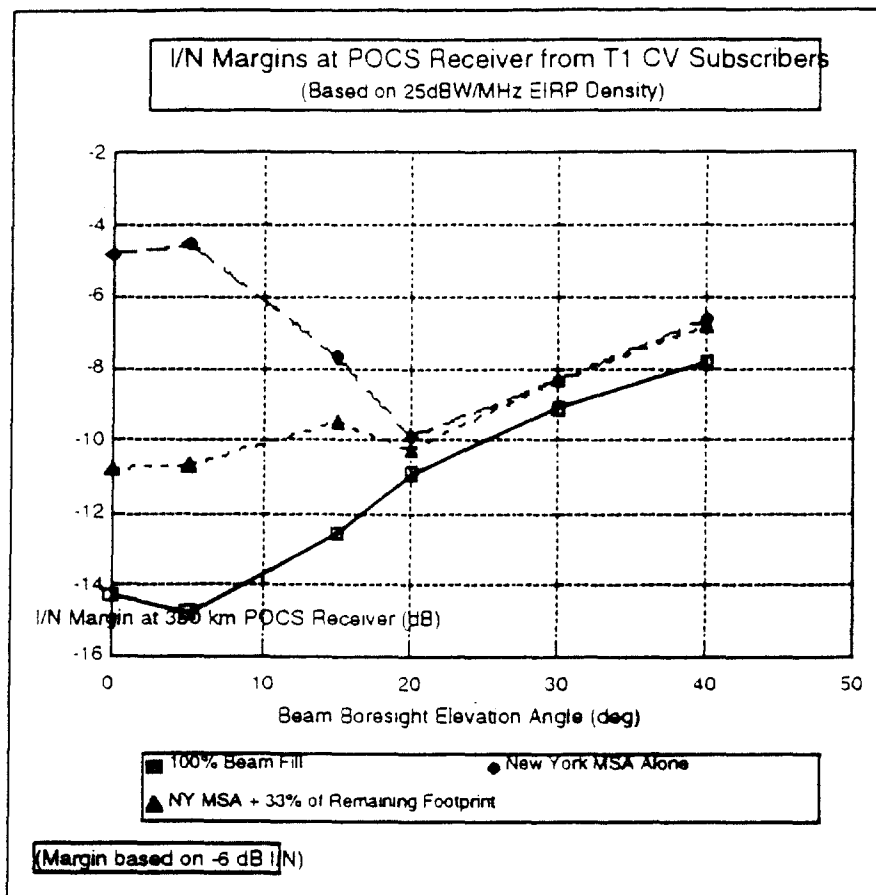


Fig B1

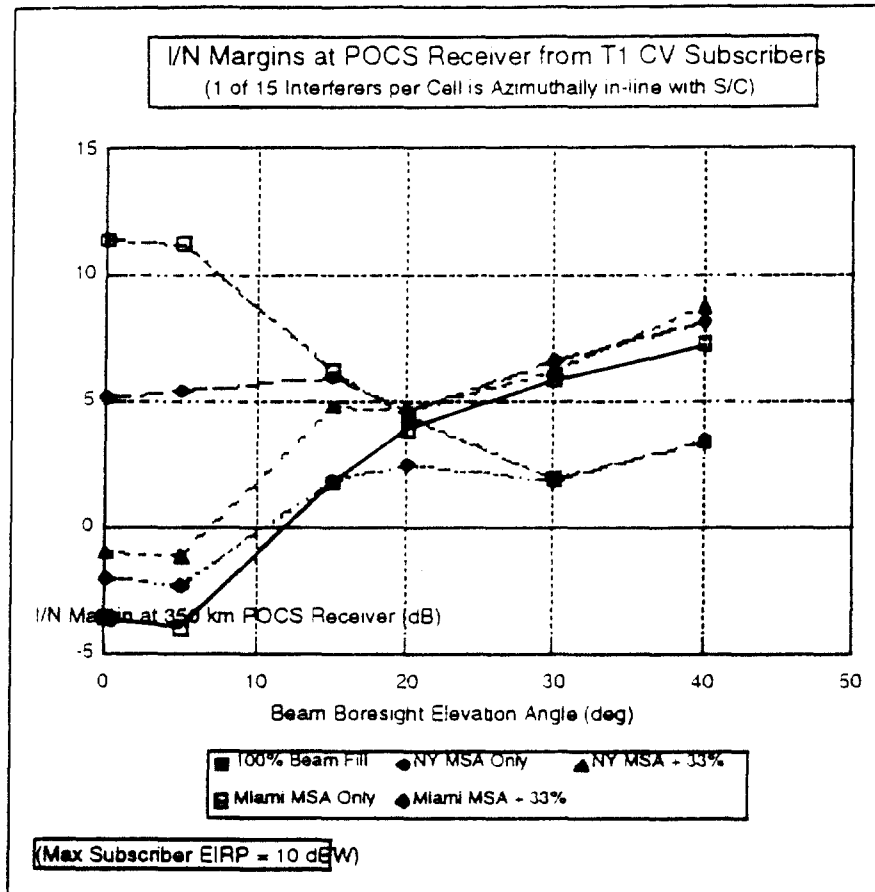


Fig 132

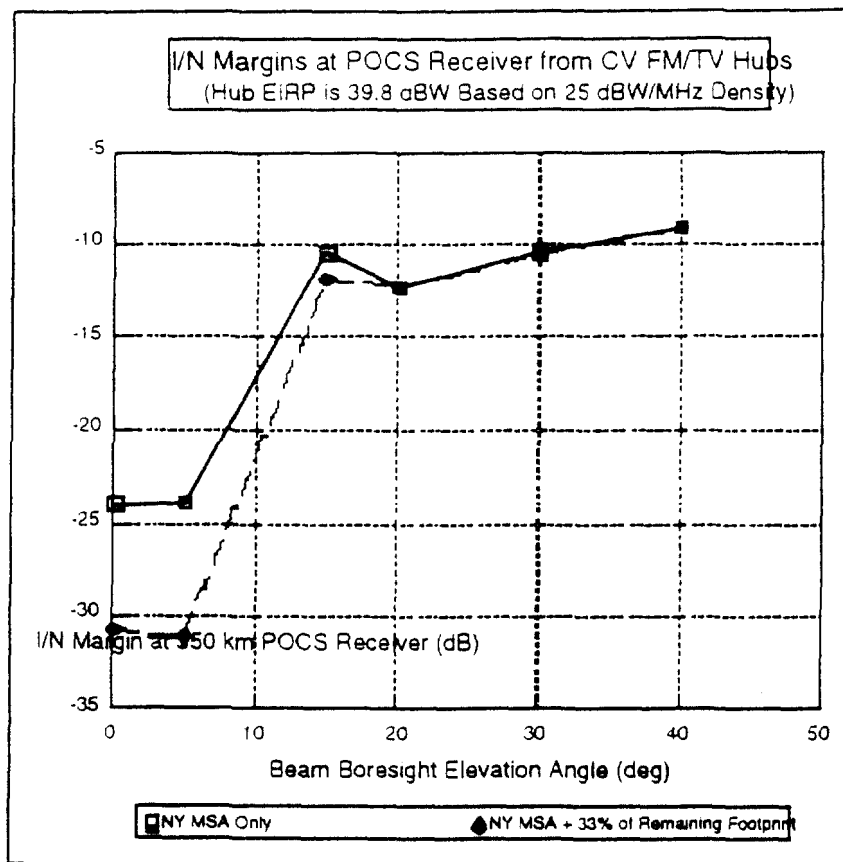


Fig B3

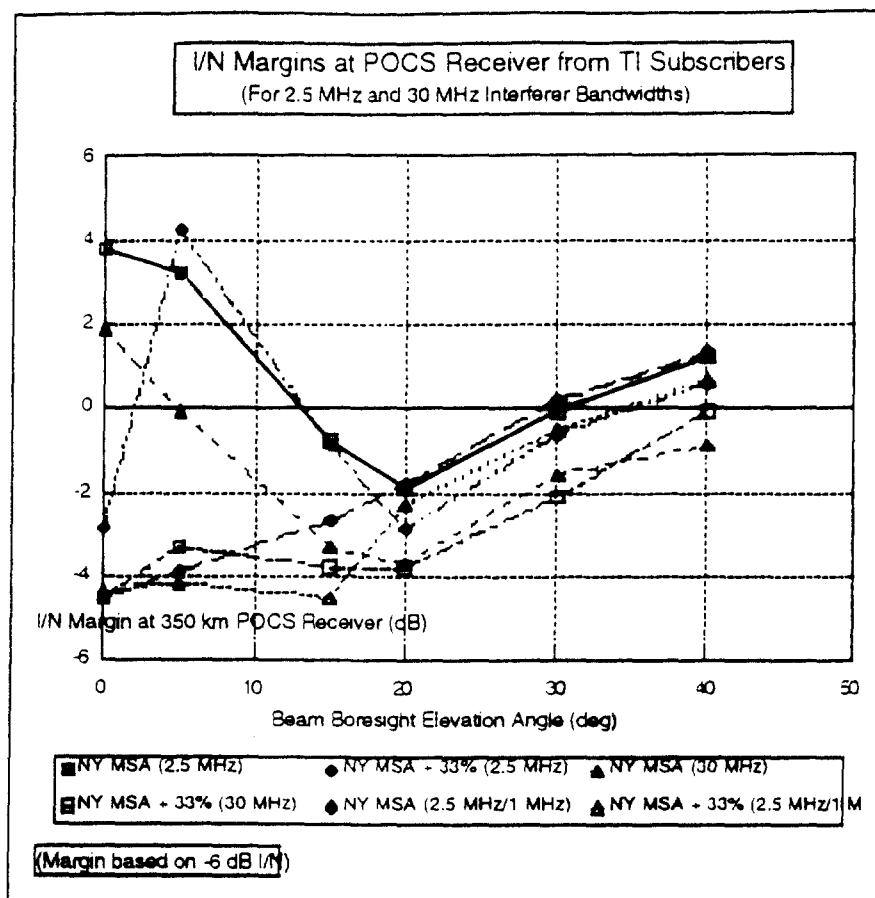
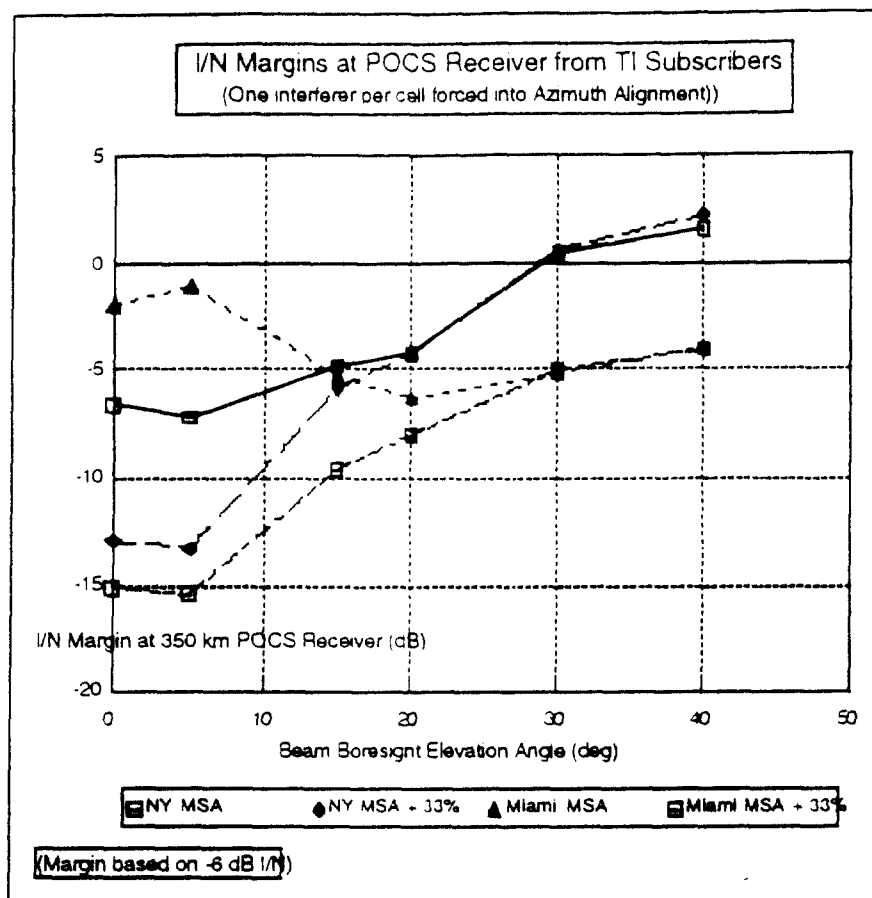
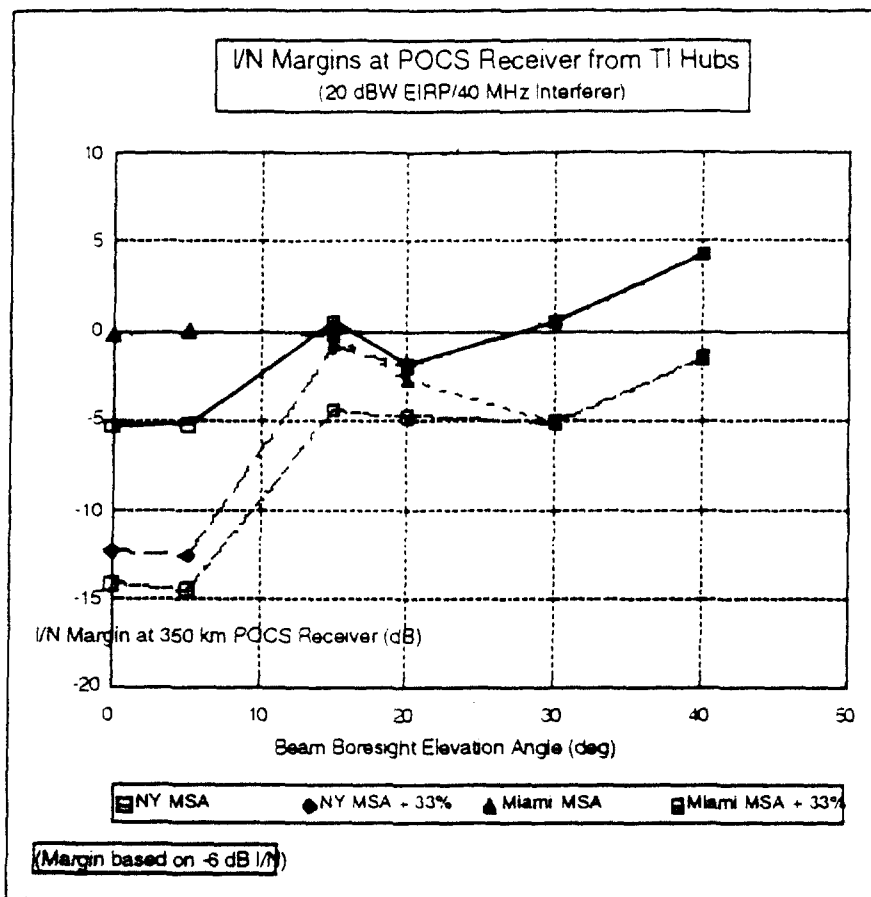


Fig B4



F_0 B5



F.8 B 6

CV LMDS INTERFERENCE INTO SPACE STATION PROX OPS RECEIVER (350 KM ALTITUDE; 5.9° RECV BEAM HPBW)

CASE #	SYSTEM	SUB/HUB	MAX EIRP (dBW)	Xmit BW Data Rate	Cell Radius (km)	Rain Zone	Recv BW (MHz)	# of inters per cell	# AZ aligned with S/C per cell	MSAs	I/N Margins (dB) at Beam Elevation Angle for 100% Coverage of SMA (or beam if so indicated)					
											0°	5°	15°	20°	30°	40°
1	CV	SUB	10.0	1 MHz/T1	4.8	2	14.7 MHz	15	0	100% of Beam	0.8	-0.2	2.3	4.3	5.9	7.8
2	CV	SUB	10.0	1 MHz/T1	4.8	2	14.7 MHz	15	1	100% of Beam	-3.6	-4.0	1.8	3.9	5.9	7.3
3	CV	SUB	25.0	1 MHz/T1	4.8	2	14.7 MHz	15	0	100% of Beam	-14.3	-14.8	-12.6	-10.9	-9.1	-7.8
4	CV	SUB	10.0	1/1 MHz/T1	2.7	1	14.7 MHz	15	0	100% of Beam	-2.6	-3.4	-1.9	-0.4	1.4	3.0
5	CV	SUB	10.0	1 MHz/T1	4.8	2	14.7 MHz	15	0	New York	11.7	11.8	6.8	4.9	6.8	8.4
6 (33%) ¹	CV	SUB	10.0	1 MHz/T1	4.8	2	14.7 MHz	15	0	New York	4.8	3.9	5.4	4.8	7.0	8.3
7	CV	SUB	10.0	1 MHz/T1	4.8	2	14.7 MHz	15	1	New York	5.2	5.4	6.0	4.6	6.6	8.2
8 (33%)	CV	SUB	10.0	1 MHz/T1	4.8	2	14.7 MHz	15	1	New York	-0.9	-1.1	4.8	4.6	6.2	8.8
9	CV	SUB	25.0	1 MHz/T1	4.8	2	14.7 MHz	15	0	New York	-0.8	-0.5	-7.7	-9.9	-8.3	-6.6
10 (33%)	CV	SUB	25.0	1 MHz/T1	4.8	2	14.7 MHz	15	0	New York	-10.8	-10.7	-9.5	-10.3	-8.3	-6.8

¹ Cases marked 33% refer to the method in which the effective area within the beam footprint area is calculated. The effective area is assumed to be that area occupied by LMDS cells. For cases marked (33%), the effective area is equal to the beam area if the beam area is less than or equal to the quantity (%coverage * A_{SMA}) which is the percent LMDS coverage (in terms of area) of the indicated SMA (statistical metropolitan area). If the beam area is greater than this quantity, then the effective area is taken to be this quantity + 33% of the beam area outside this area (i.e. A_{eff} = (%coverage * A_{SMA}) + 0.33 * (A_{beam} - %coverage * A_{SMA})). For cases not marked (33%), A_{eff} = A_{beam} for A_{beam} ≤ %coverage * A_{SMA} and A_{eff} = %coverage * A_{SMA} for beam areas greater than %coverage * SMA (i.e. the rest of the beam area is assumed to be empty of LMDS cells).

Table B1

11	CV	SUB	10.0	1 MHz/T1	2.7	1	14.7 MHz	15	0	Miami	17.5	17.2	7.0	5.0	2.2	3.7
2(33%)	CV	SUB	10.0	1 MHz/T1	2.7	1	14.7 MHz	15	0	Miami	3.4	2.9	2.9	2.7	1.9	3.8
13	CV	SUB	10.0	1 MHz/T1	2.7	1	14.7 MHz	15	1	Miami	11.4	11.2	6.2	4.4	2.0	3.4
4(33%)	CV	SUB	10.0	1 MHz/T1	2.7	1	14.7 MHz	15	1	Miami	-2.0	-2.3	1.9	2.5	1.9	3.5
15	CV	SUB	5.0	10 kHz/16 kbps	4.8	2	500 kHz	50	0	New York	-3.7	-4.6	-8.0	-10.0	-8.0	-6.4
6(33%)	CV	SUB	5.0	10 kHz/16 kbps	4.8	2	500 kHz	50	0	New York	-	-10.6	-9.6	-10.1	-8.1	-6.7
											10.3					
17	CV ^{**}	SUB	39.8	30 MHz/45 Mbps	4.8	2	14.7 MHz	1	0	New York	-4.7	-2.2	-8.7	-11.1	-8.3	-6.1
18 (33%)	CV	SUB	** 39.8	30 MHz/45 Mbps	4.8	2	14.7 MHz	1	0	New York	-	-11.8	-	-10.2	-7.1	-6.0
											10.2		10.1			
19	CV	HUB	7.0	20 MHz FM/TV	4.8	2	14.7 MHz	1	0	New York	6.8	7.0	20.4	18.7	20.3	21.8
20 (33%)	CV	HUB	7.0	20 MHz FM/TV	4.8	2	14.7 MHz	1	0	New York	0.2	0.0	19.1	18.7	20.3	21.8
21	CV	HUB	38.0	20 MHz FM/TV	4.8	2	14.7 MHz	1	0	New York	-	-24.0	-	-12.3	-10.6	-9.2
											24.1		10.6			
22 (33%)	CV	HUB	38.0	20 MHz FM/TV	4.8	2	14.7 MHz	1	0	New York	-	-31.1	-	-12.3	-10.6	-9.2
											30.8		11.9			
23	CV	HUB	7.0	20 MHz FM/TV	4.8	2	14.7 MHz	1	0	New York + Phila + Wash DC	1.3	1.3	-	-	-	-
24 (33%)	CV	HUB	7.0	20 MHz FM/TV	4.8	2	14.7 MHz	1	0	New York + Phila + DC	-1.4	-1.6	-	-	-	-
25	CV	SUB	10.0	1 MHz/T1	4.8	2	14.7 MHz	15	0	New York + Phila + DC	5.4	4.9	-	-	-	-
26 (33%)	CV	SUB	10.0	1 MHz/T1	4.8	2	14.7 MHz	15	0	New York + Phila + DC	2.9	2.7	-	-	-	-

Table B2